

$$0 = \frac{k_f}{r} \frac{d}{dr} \left(r \frac{dT_f}{dr} \right) + q''' \quad r < r_{fo} \quad (1)$$

$$0 = \frac{k_c}{r} \frac{d}{dr} \left(r \frac{dT_c}{dr} \right) \quad r_{ci} < r < r_{co} \quad (2)$$

$$T_f \text{ é finita em } r=0 \quad (3)$$

$$-k_c \frac{dT_c}{dr} = h(T_c - T_m) \quad \text{em } r=r_{co} \quad (4)$$

$$-k_f \frac{dT_f}{dr} \Big|_{r=r_{fo}} = -k_c \frac{dT_c}{dr} \Big|_{r=r_{ci}} \quad (5)$$

$$q''_g = h_g(T_{fo} - T_{ci})$$

$$-k_f \frac{dT_f}{dr} \Big|_{r=r_{fo}} = 2\pi r_g h_g(T_{fo} - T_{ci}) \quad (6)$$

fazendo: $\frac{d}{dr} \left(r \frac{dT_f}{dr} \right) = -\frac{q''' r}{k_f}$

$$\frac{dT_f}{dr} = -\frac{q''' r}{2k_f} + \frac{C_1}{r} \quad C_1 = 0$$

$$-k_f \frac{dT_f}{dr} \Big|_{r=r_{fo}} = \frac{q''' r}{2} \Big|_{r=r_{fo}} = \frac{q''' r_{fo}}{2} = q''_{fo} \quad \text{definição}$$

$$\frac{d}{dr} \left(r \frac{dT_c}{dr} \right) = 0$$

$$r \frac{dT_c}{dr} = C_2$$

$$-k_f \frac{dT_f}{dr} \Big|_{r_{fo}} = -k_c \frac{dT_c}{dr} \Big|_{r_{ci}}$$

$$\frac{q''' r_{fo}}{2} \cdot 2\pi r_{fo} = -k_c \frac{dT_c}{dr} \Big|_{r_{ci}} \cdot 2\pi r_{ci}$$

mas: $\frac{q''' r_{fo}}{2} \cdot 2\pi r_{fo} = q''' \pi r_{fo}^2 = q'$